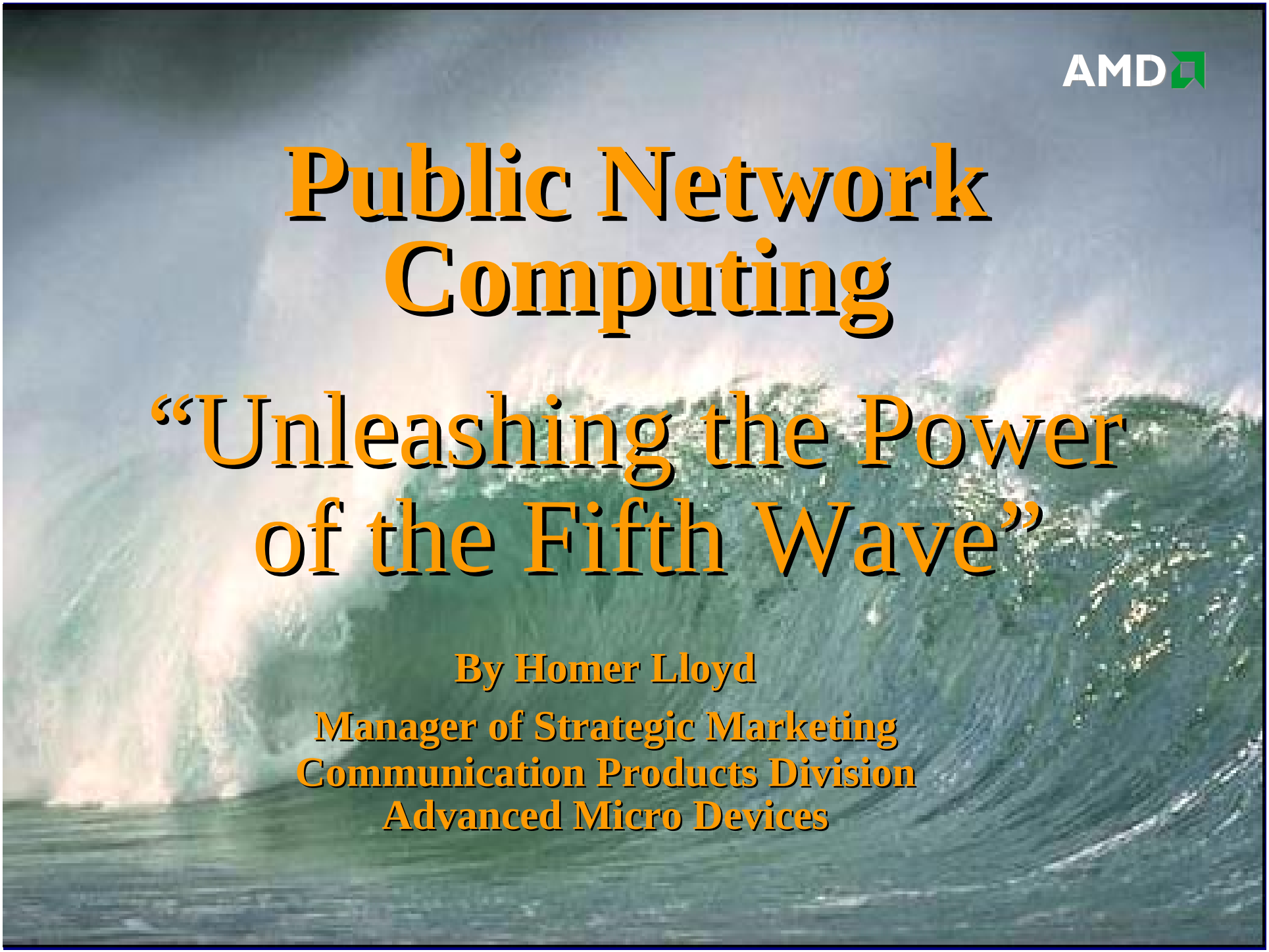
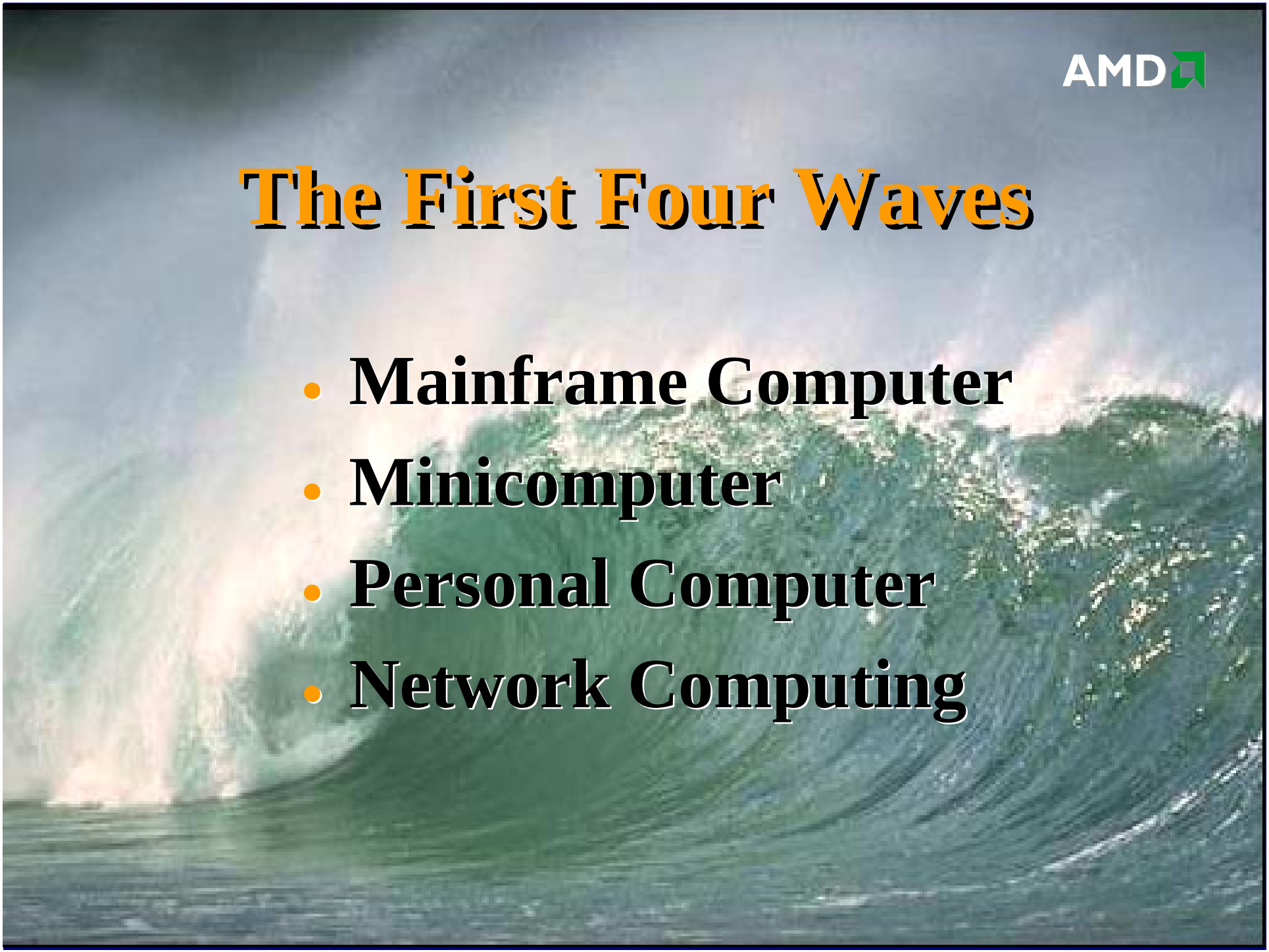


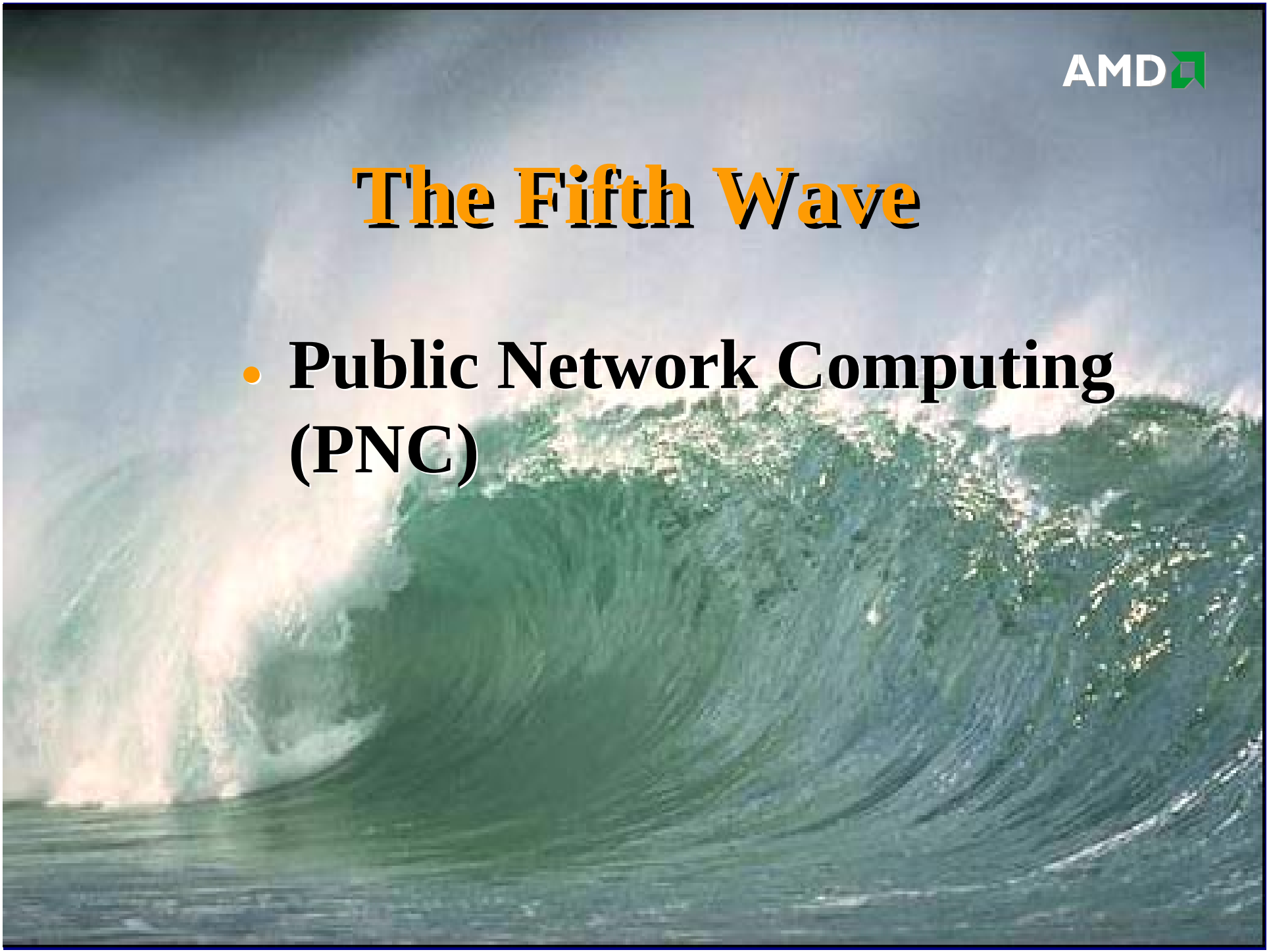
Public Network Computing

"Unleashing the Power of the Fifth Wave"

By Homer Lloyd

Manager of Strategic Marketing
Communication Products Division
Advanced Micro Devices


AMD
The First Four Waves
Mainframe Computer
Minicomputer
Personal Computer
Network Computing



The Fifth Wave

- Public Network Computing (PNC)

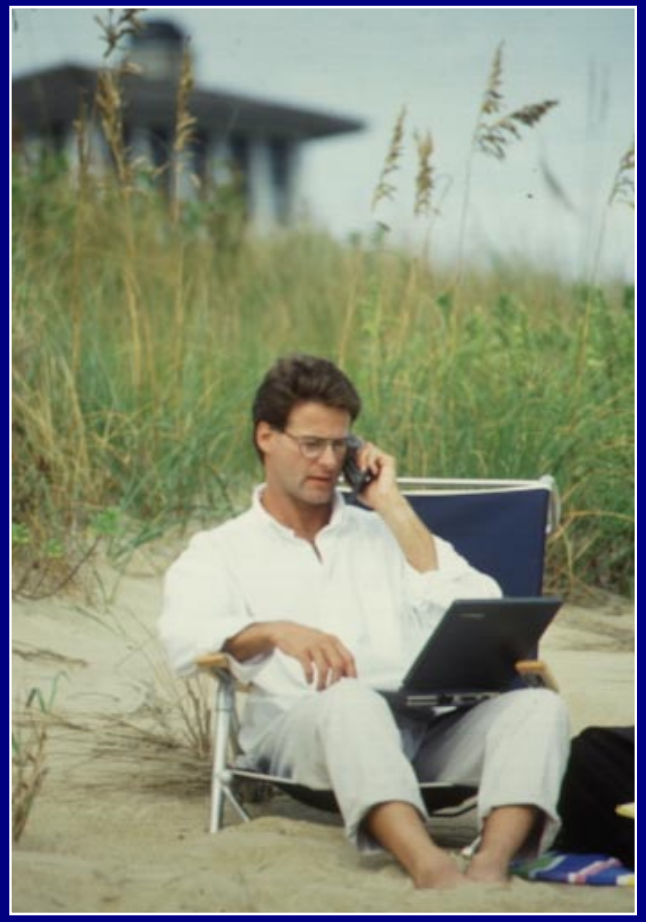
Public Network Computing

Wireless Technology is enabler for PNC

- Cost of Cellular/PCS approaching that of wireline
- Data transmission rates are on par with ISDN
- Wireless LANs finding applications in the home
- Wireless Local Loop bringing POTS to everyone

Public Network Computing

What are the forces driving this next wave?



The Mass Consumer - The need for ubiquitous connectivity utilizing higher bandwidth technologies for both wired and wireless infrastructures

Public Network Computing

Driving Forces - Two Categories

- Information Access
- Voice Communications

Public Network Computing

Information Access - The Internet

Applications:

On-Line Shopping

Entertainment

Financial Services

Communications - email/voice

Telecommuting

Public Network Computing

- Voice Communications

Wireless Technologies	Wired Technologies
Wireless Local Loop	Copper POTS
Digital Cordless	ISDN
Digital and Analog Cellular	xDSL
PDA’s	

Public Network Computing

Wireless Local Loop

- In developing nations, an enabling technology that will bring POTS to the masses
- In developed nations, a way for new providers to compete with the local exchange carriers for local service

Public Network Computing

Wireless Local Loop

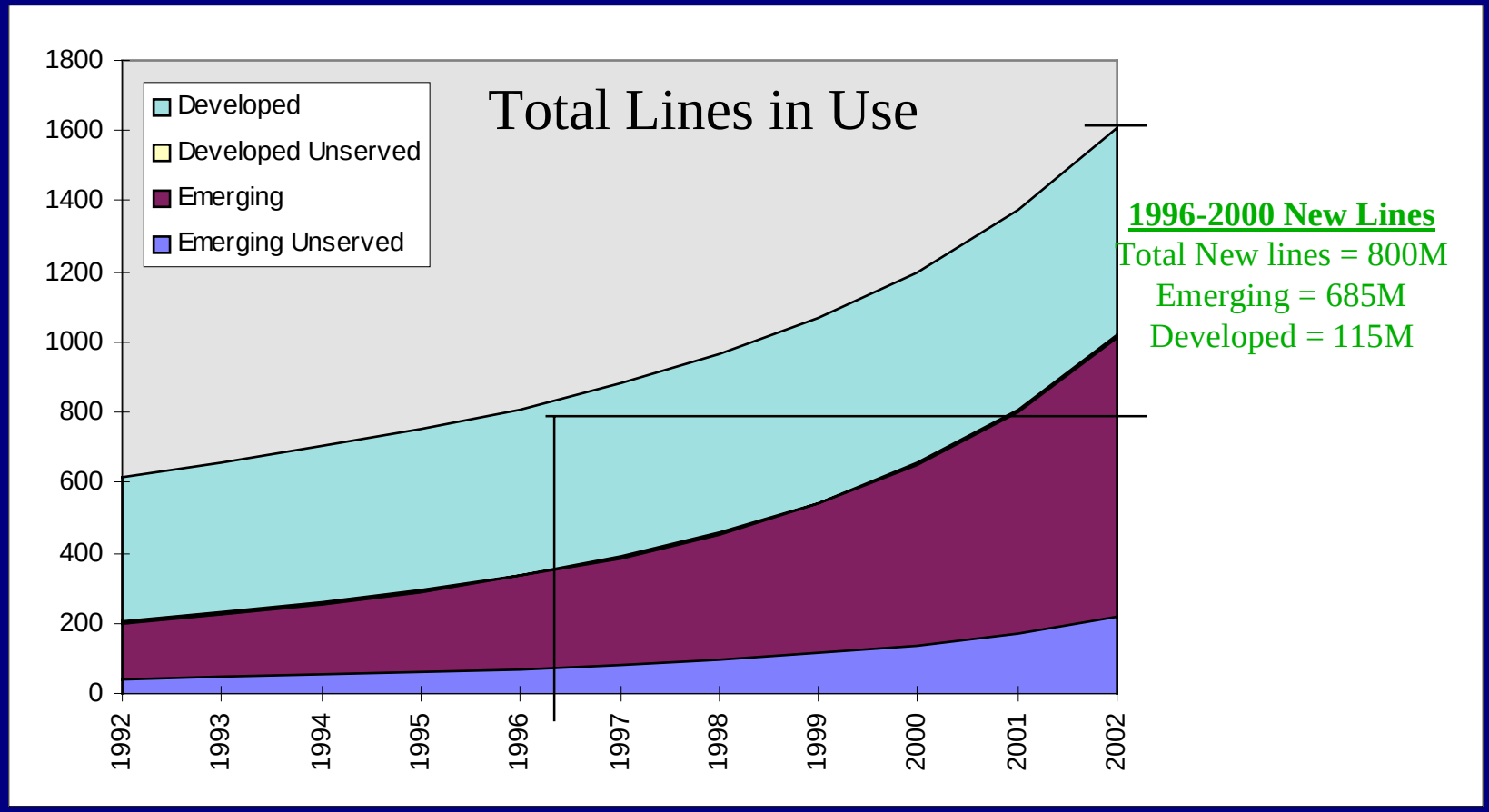
- WLL field trials and installations are using many different technologies.
  - How large will the market be?
  - What system technologies will be important?
  - What semiconductor technologies are required in this market?

Emerging Wireless Local Loop Market Overview

WLL Market Conclusions

- Market is embryonic but growing rapidly
- Clear opportunity in emerging economies
- Enormous potential upside in developed economies
- More than one technology will evolve as leader:
  - Microcellular such as DECT and PHS
  - Macrocellular such as TDMA, CDMA, GSM

Worldwide Local Loop Demand



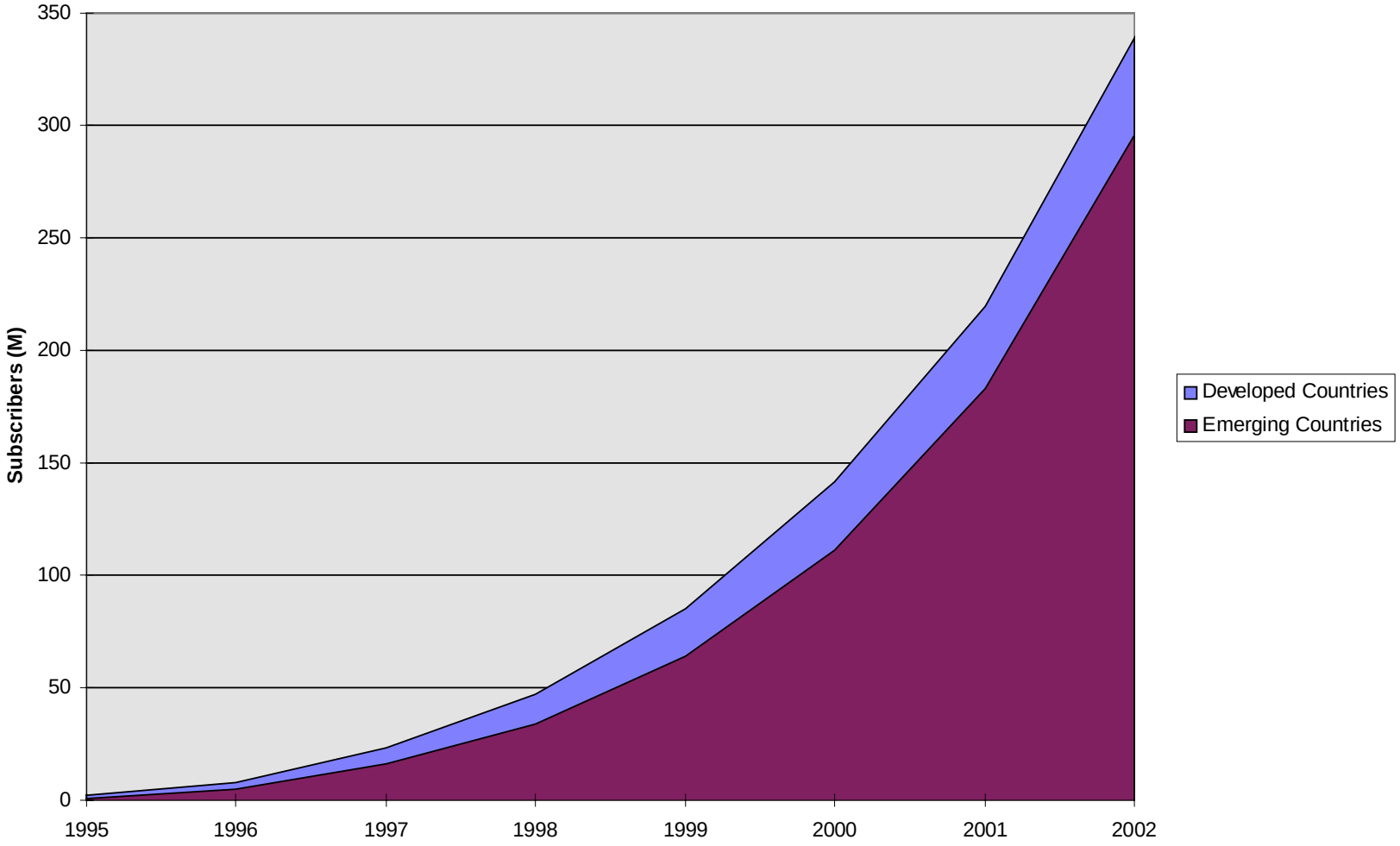
Source: ITU/AMD

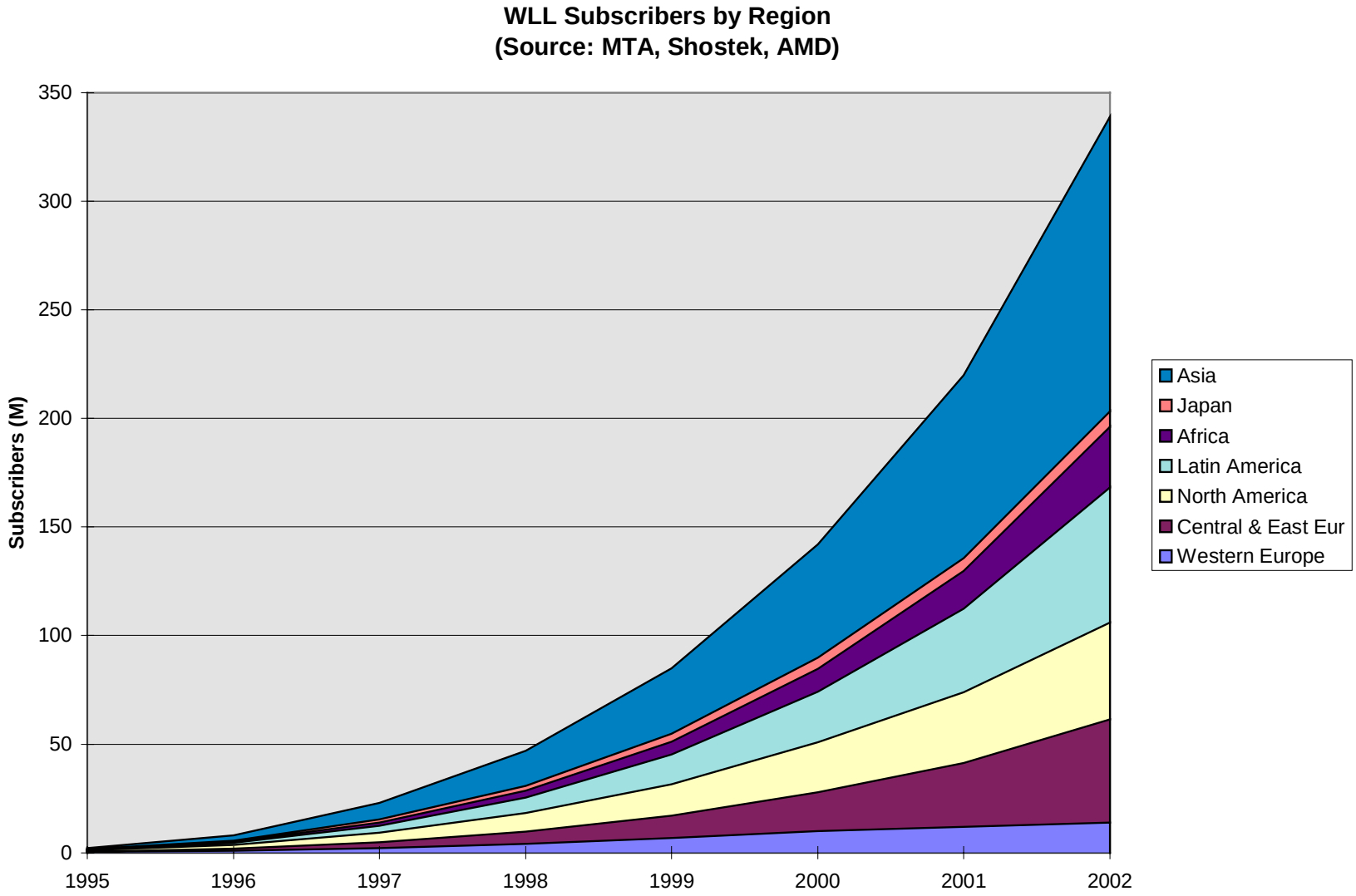
Worldwide Local Loop - Assumptions

- Based on ITU historical data from 1992 - 1994
- Assumes growth rate for each country remains the same as 1992-1994
- Unserved demand is people on official waiting lists as of 1994 (43M) - source: ITU
- Unserved demand remains a constant percentage of installed lines

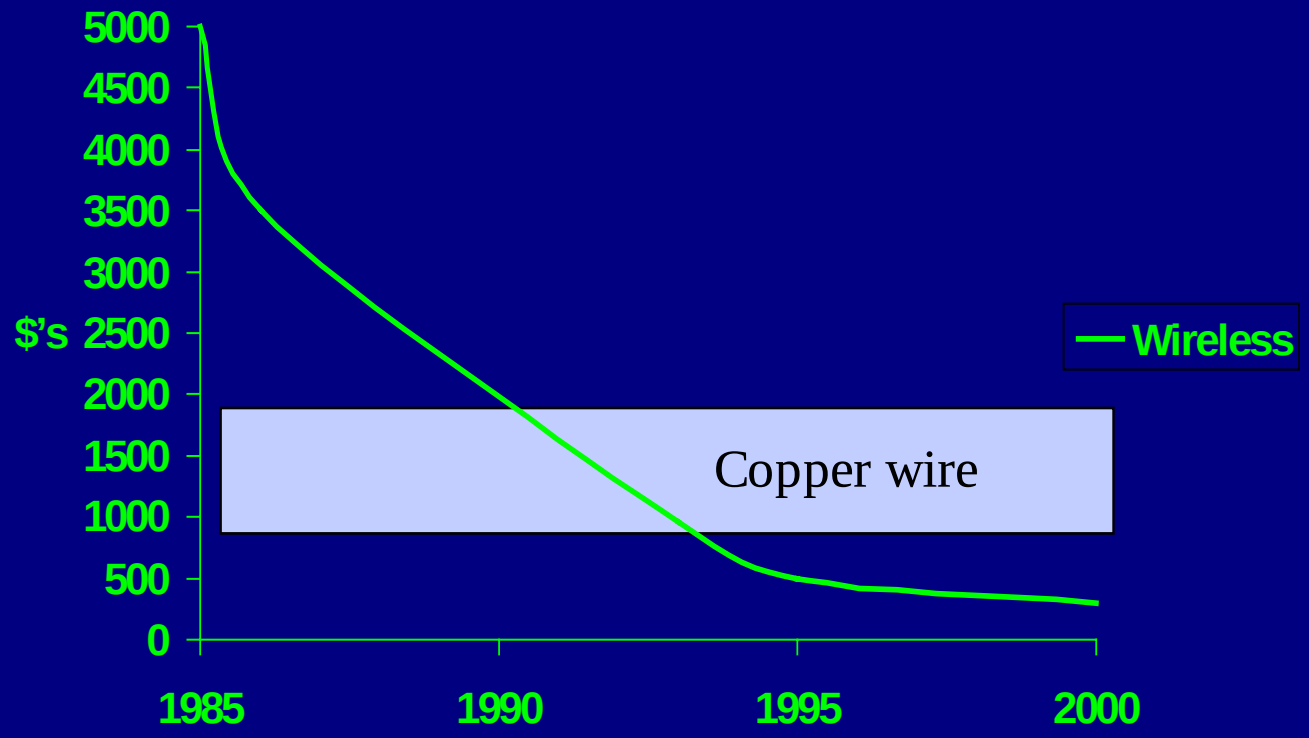
WLL Market Segmentation

- Market segments:
  - Basic phone service in Emerging Economies
    - » POTS and analog MODEM services
    - » Technologies: Analog/Digital cellular, DECT, PHS, Proprietary
  - Wireless By-Pass in Developed Economies -
    - » POTS, High Speed MODEM service, ISDN (2B+D), enhanced services, limited mobility
    - » Technologies: Digital cellular, proprietary, DECT, PHS


Worldwide Wireless Local Loop Subscribers
Source: MTA, Shostek, AMD
Subscribers (M)
350
300
250
200
150
100
50
0
1995
1996
1997
1998
1999
2000
2001
2002
Developed Countries
Emerging Countries


WLL Subscribers by Region
(Source: MTA, Shostek, AMD)
Subscribers (M)
350
300
250
200
150
100
50
0
1995
1996
1997
1998
1999
2000
2001
2002
Asia
Japan
Africa
Latin America
North America
Central & East Eur
Western Europe

Why WLL? - Cost of the last mile



Source: Herschel Shosteck Associates

WLL vs. Copper

- Cost
  - Low Incremental investment cost
  - Much cheaper at lower subscriber densities
  - Quicker time to positive cash flow
- Ease and speed of service implementation
- Scalability and Versatility
- Maintenance and reliability

Market Segmentation - Requirements

	Developed (Bypass)	Emerging (Basic POTs)
Urban/ Sub-urban	Hi-speed data Enhanced services Limited mobility High traffic/subscriber densities	POTS (voice quality) Modem data No (limited) mobility High traffic/subscriber densities
Rural	Same as above, but: Low subscriber densities Wide coverage	Same as above, but: Low subscriber densities Wide coverage

Market Split - New Installations in the year 2000 (Total = 60MU)

	Developed	Emerging
Urban/ Sub-urban	9% + "Bypass upside" potential of 25%	**51%**
Rural	6% + "Bypass upside" potential of 10%	34%

Source: AMD, Shosteck

WLL Today

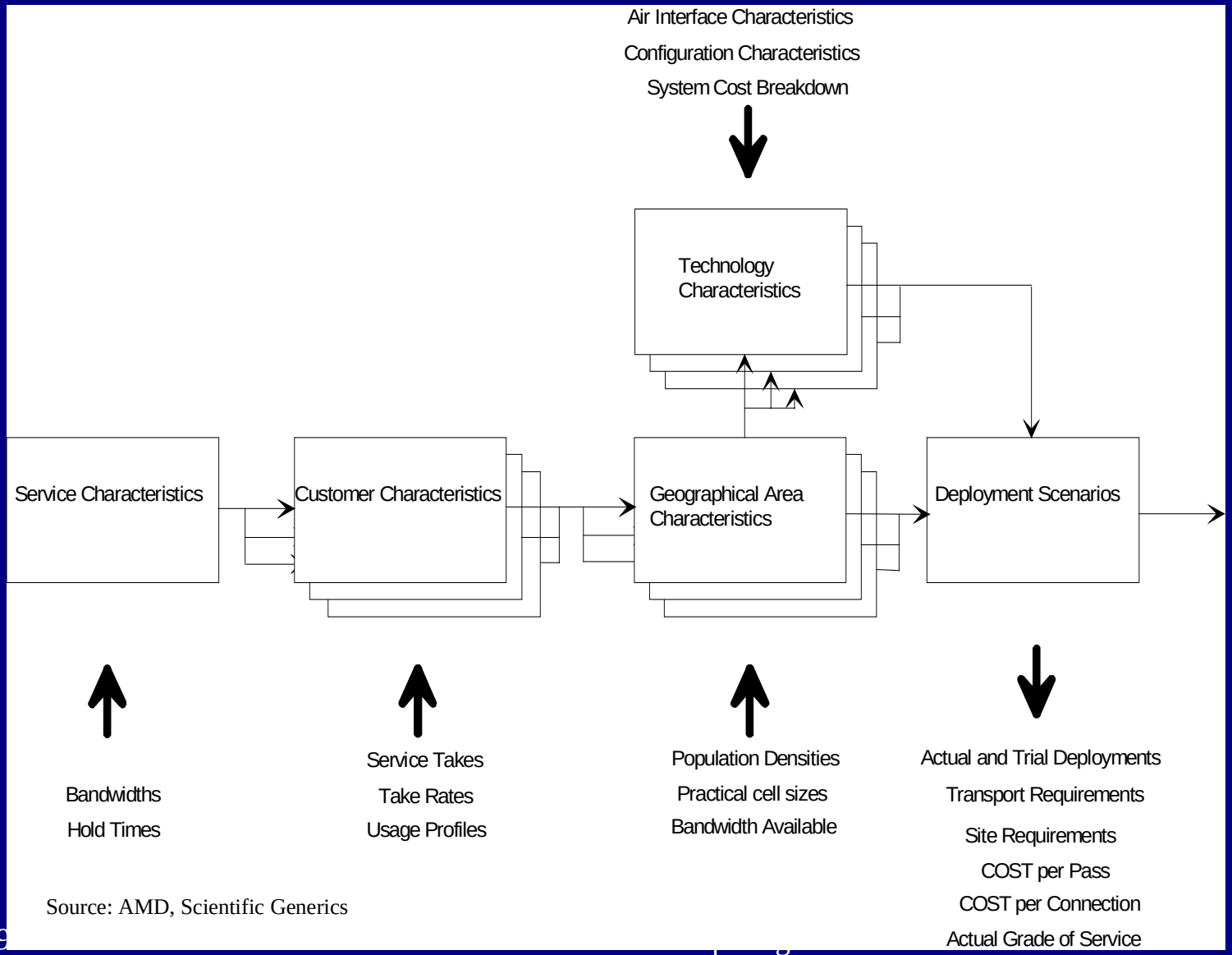
- Total installed = 825K, potential 18M
  - 14M of potential is in China
- Most installations today are in field trial
- Market leaders today are major Telecom companies like Alcatel, Ericsson, Lucent, Motorola, NEC, Nortel
- Many technologies used:
  - AMPS, TACS, CDMA, GSM, DECT, PHS

Comparison of WLL Systems

Comparison of WLL Systems

- Scenarios considered:
  - Developing world - Rural - Low penetration
  - Developing world - Rural - High Penetration
  - Developing world - Urban - Low penetration
  - Developing world - Urban - High Penetration
  - Developed world - Local loop Bypass

Computer Analysis Model



Source: AMD, Scientific Generics

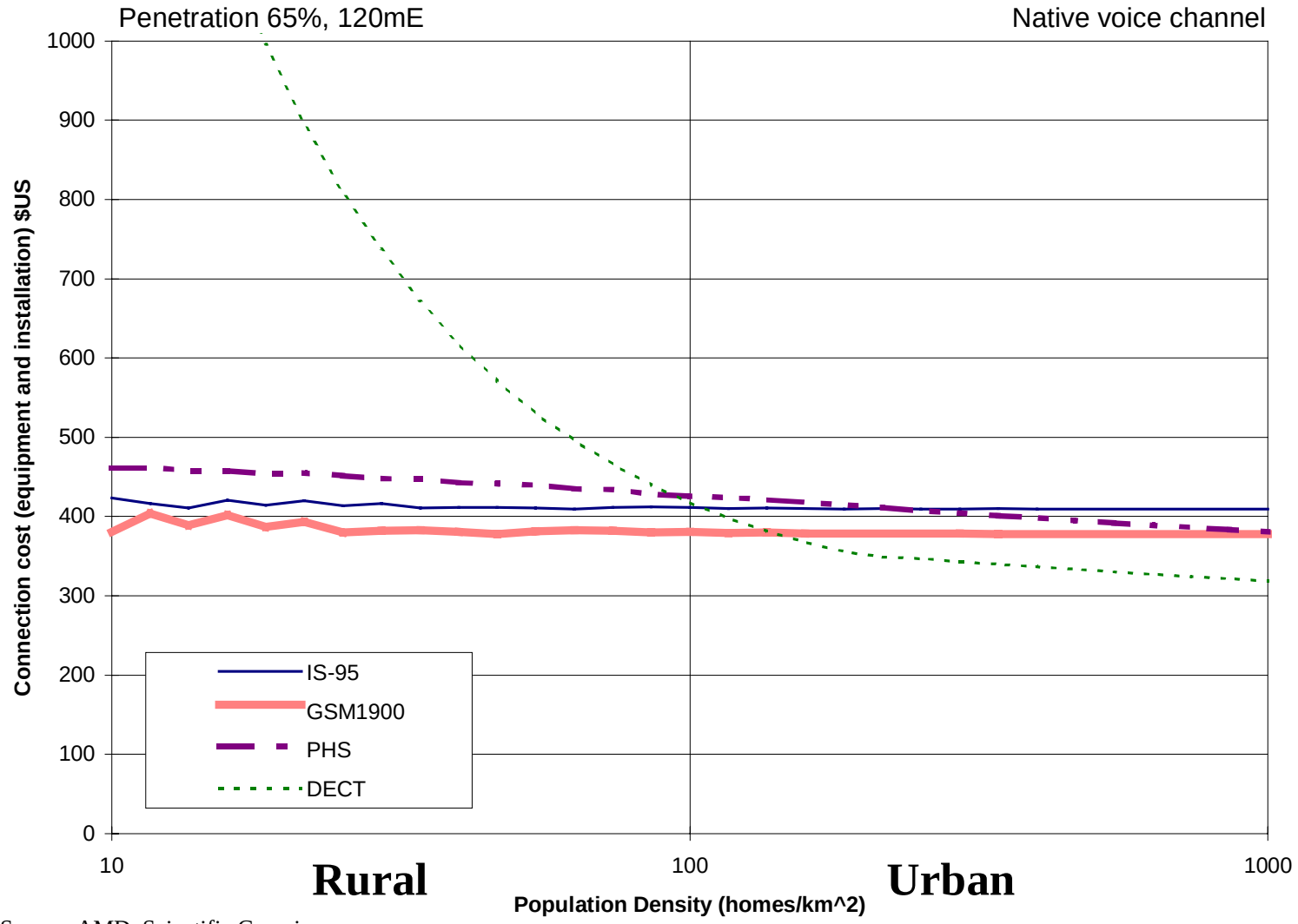
Parameters Included in Model

- Modulation scheme (gives C/I requirement and bits per symbol)
- Transmitted symbol rate (or chip rate in CDMA systems)
- Channel symbol rates (for CDMA systems)
- Transmitted powers
- Antenna gains (vary with cell sectorization)
- Channels per carrier
- Carrier spacing
- Coding or equalization employed

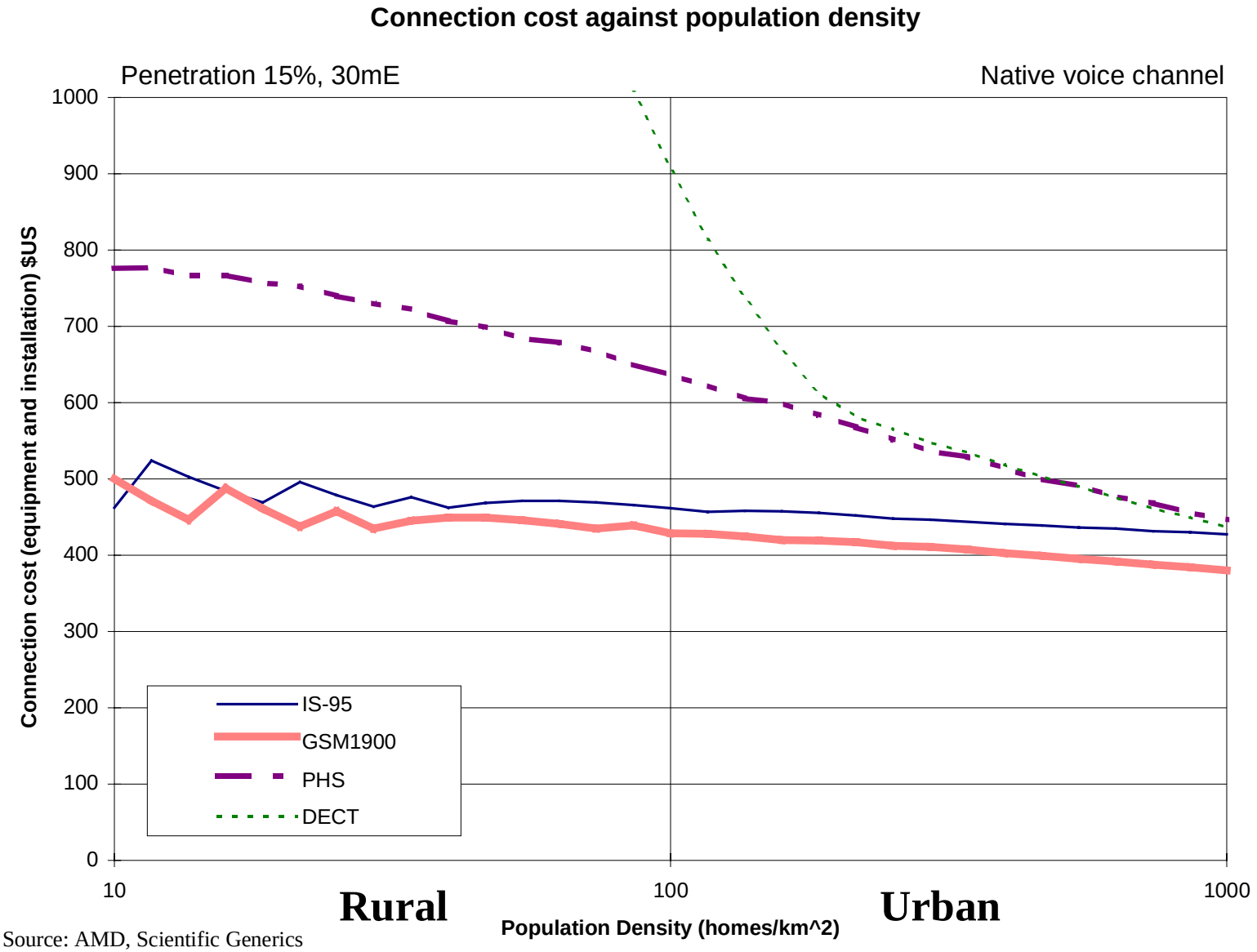
Costs Included in Model

- Base station site and infrastructure costs
- Costs of radio equipment (varies with channels used per site)
- Costs of antenna equipment (varies with sectorization of base station)
- Costs of baseband processing and protocol conversion equipment
- Costs of backhaul from base station
- Costs of subscriber premises equipment
- Installation costs

Connection cost against population density



Source: AMD, Scientific Generics



Source: AMD, Scientific Generics

Notes to Analysis

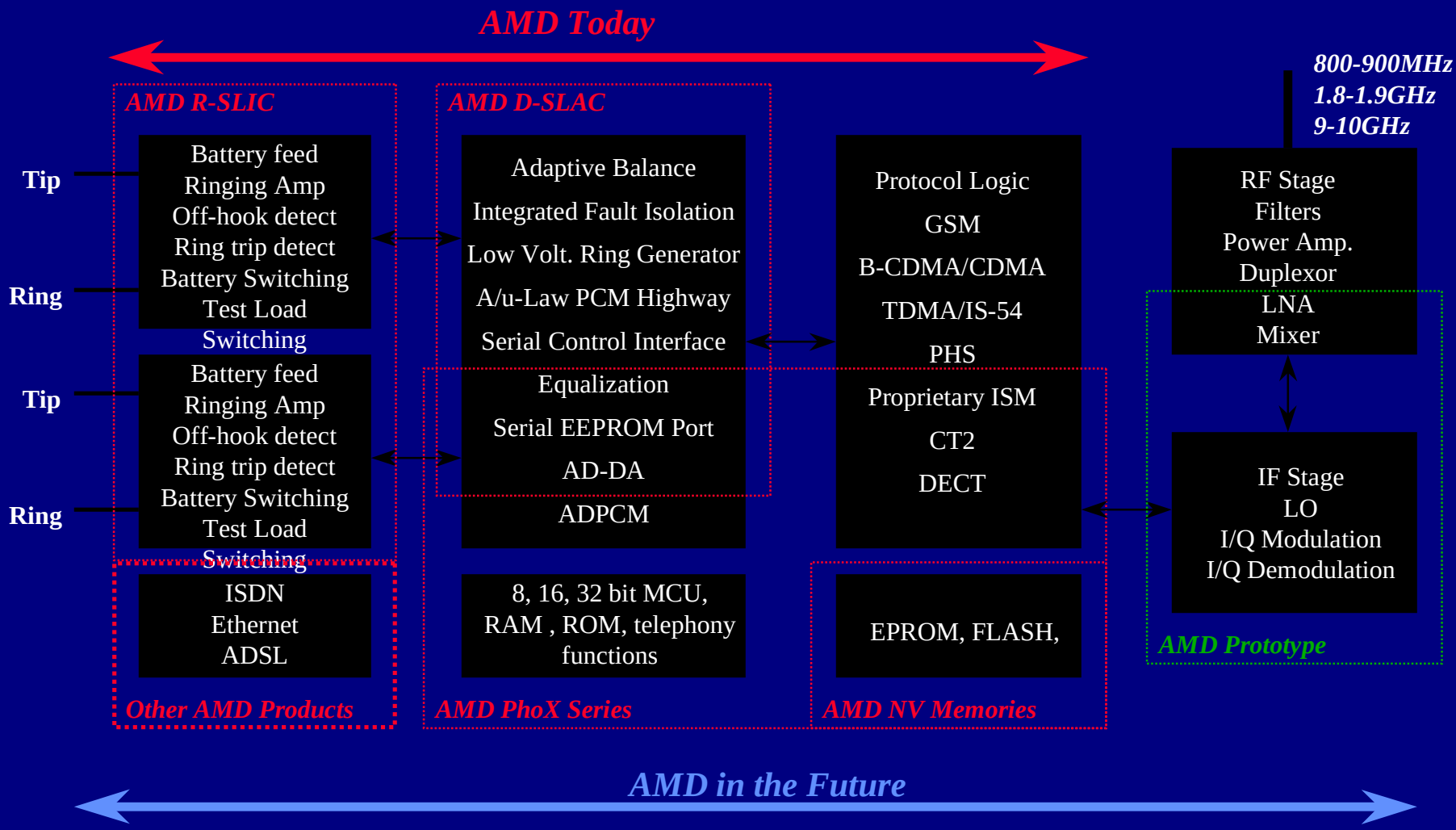
- Cost depends on many factors including subscriber density, traffic, services, backhaul costs, equipment costs:
  - Analysis assumes backhaul costs similar for all systems, probably wrong for microcellular!
  - The costs are for installation only, does not include operation and maintenance or system and subscriber management software
  - Incremental investment costs must be considered

Market Segmentation - Technologies

	Developed	Emerging
Urban/ Sub-urban	Digital Cellular DECT PHS Proprietary	DECT PHS Digital Cellular Proprietary
Rural	Digital Cellular Proprietary	Digital Cellular Analog Cellular Proprietary

Semiconductors for WLL

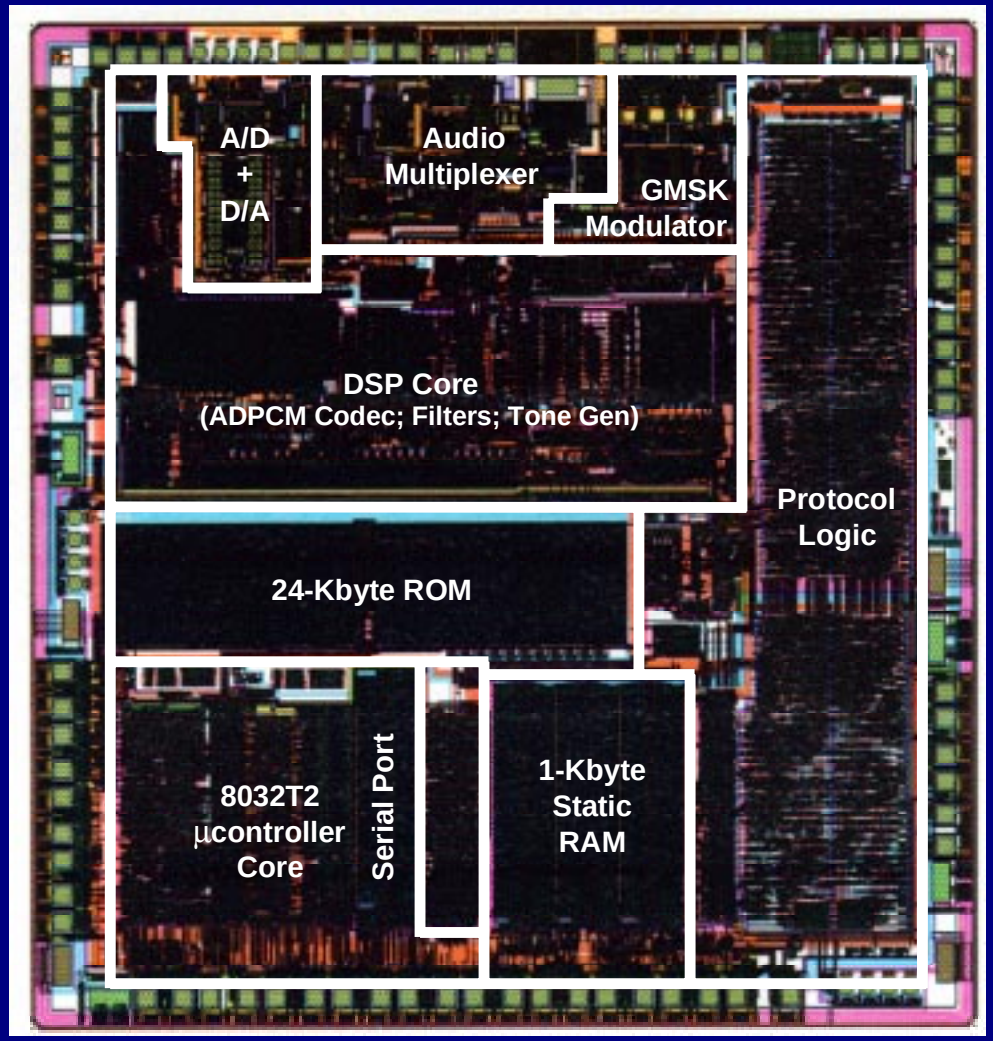
WLL Digital Subscriber Terminal



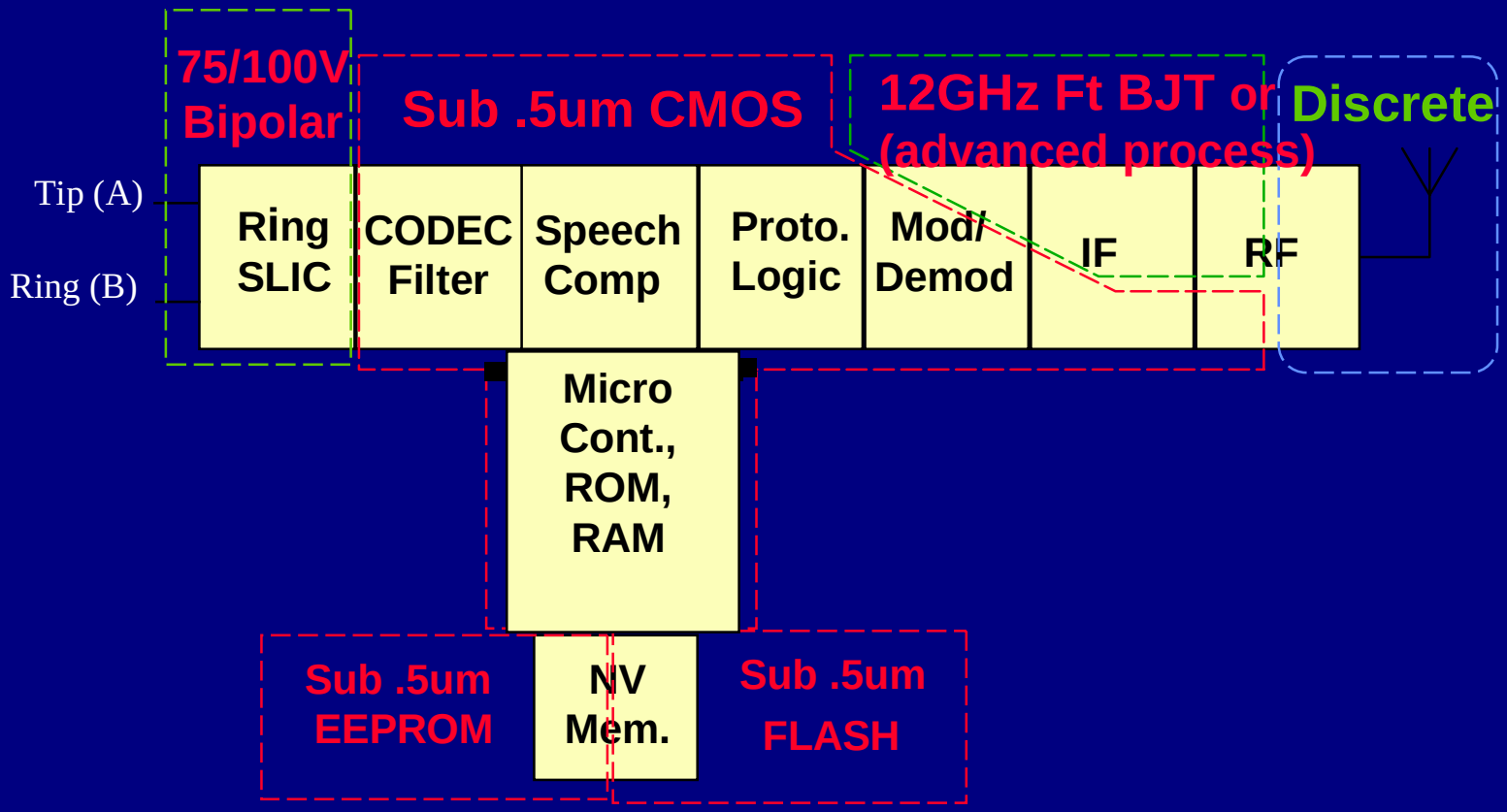
Semiconductor Requirements

- Must be low cost to enable mass deployment - integration
  - High integration means < .5 micron CMOS
- Antennae to Tip/Ring solutions require multitude of technologies
  - High voltage Tip/Ring interface
  - Dense, non-volatile memory
  - High speed CMOS
  - RF/IF requires low noise, high speed

Example of Integration: 79C412 PhoX



Technology Partitioning for Low Cost WLL Solutions



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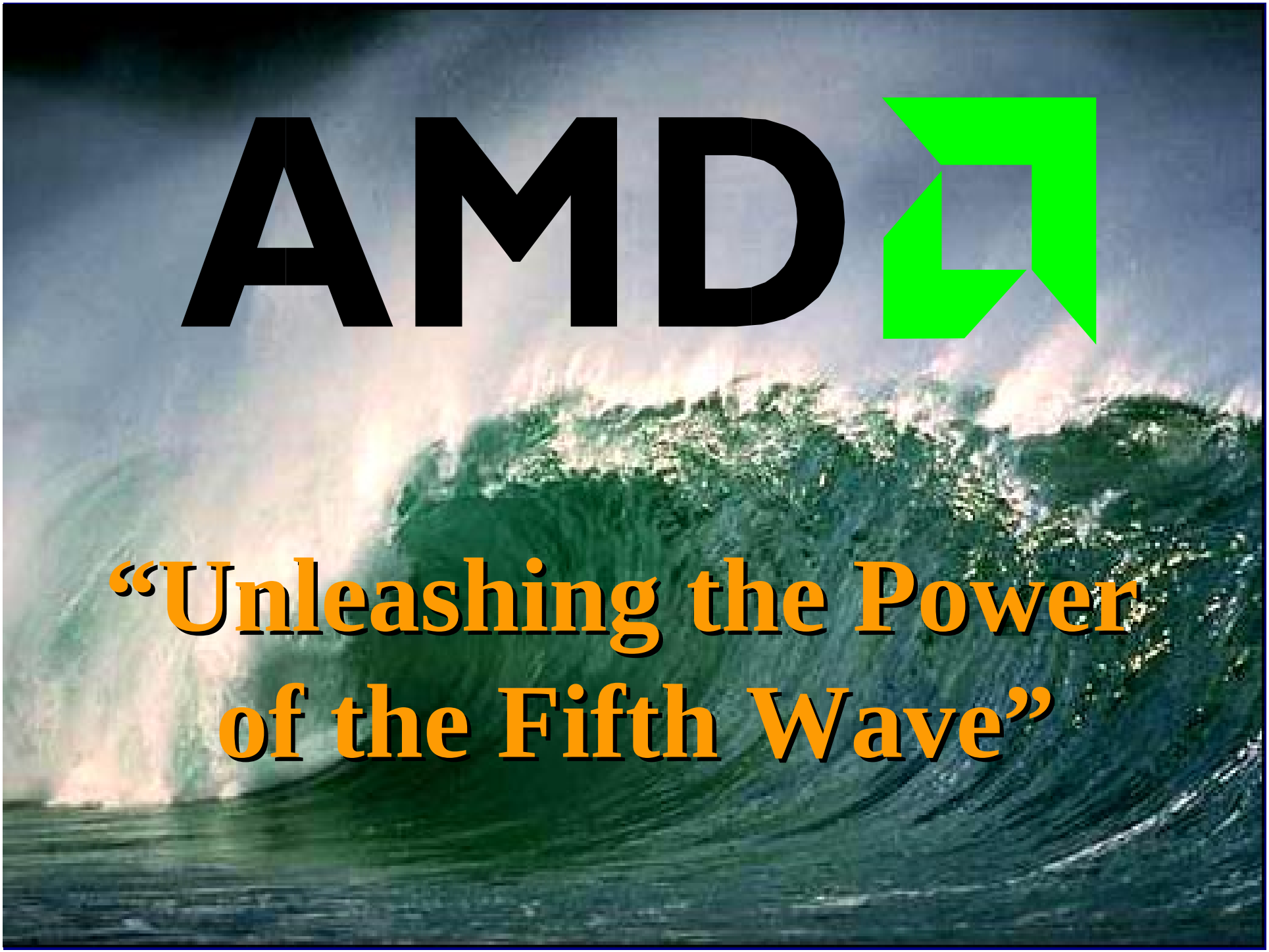
WLL System Comparison Conclusion

- No one system is best for all applications:
  - Subscriber densities
  - Traffic conditions
  - Data support requirements
- Traditional wisdom that Microcellular (cordless) systems are better for urban areas and Macrocellular (cellular) systems are better for rural areas is not true for all conditions!

Conclusion

- How large will the market be?
  - Huge potential market, but -- requires the right cost and features
- Will standards evolve?
  - Yes, but more than one
- What semiconductor technologies are required in this market?
  - Antennae to Tip/Ring solutions require many technologies for lowest cost solution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